Time Efficient Training

Brijesh Patel, MA, CSCS

Walk into any commercial gym or weight-room and you will see people performing many different activities and exercises. Some individuals use free weights, while others use machines. Some individuals use high repetition sets, some use low rep sets, while others may even train one set to failure. These methods are all accepted by those in the strength and conditioning realm, but very few people implement one important element that we experience every day as a training factor…Time!? Let me explain.

The Missing Link

How many of you out there refer to the age old standards of repetition ranges for a specific goal? (i.e. 1-7 reps for strength; 8-12 for size; greater than 12 for muscular endurance (1)) That is all well and good, but what if I tell you that those rep ranges may not mean that much if you do not factor in one often overlooked training variable. Most experts agree that the principle of overload states that for a training adaptation to occur, a physiological system must be exercised at a level beyond which, it is presently accustomed. During continued overload, the physiological systems of the body will continue to adapt to the imposed stress of the exercise (1). This means that a certain amount of stress must be placed upon a physiological system for it to adapt to the stress and improve. The aforementioned repetition ranges are often used to help create this overload that we are all looking for to get those big time strength and size gains. However, this technique may not be that effective. My suggestion is to disregard rep ranges and concentrate on the time of movement spent on a certain exercise as a means to increase overload. This concept is known as Time Under Tension (TUT).

Time Under Tension (TUT)

TUT is the total amount of time your muscle(s) is under stress (tension) during any movement. For example, while dumbbell bicep curling, keep your eyes on a clock (with a second hand); the moment you begin to curl the weight to the moment you stop the exercise indicates your TUT for that movement. The TUT concept implies that your muscles must be kept under tension for a certain amount of time to stimulate strength and size gains. Before we get to the TUT guidelines, there are some underlying factors that examine how TUT exactly works.

TUT and Energy Systems

Exercise is dependent upon the energy systems of the body. Our bodies must produce energy to allow us to move and exercise. The duration and intensity of exercise will dictate which fuels are used and how many motor units will be recruited to complete the movement. There are three main systems in the body that provide energy to us. The Phosphagen (ATP/CP) system provides energy for activities lasting from 0-10 seconds. Fast Glycolyis (anaerobic) provides energy for activities lasting 15-30 seconds in duration. Glycolysis and the oxidative system (aerobic) provide energy for activities lasting 1-3 minutes in duration, while the oxidative system provides energy for those activities lasting greater than 3 minutes. The intensity of exercise will determine the energy system used (see table 1 below). Intensity in the following table may be assessed in terms of the total number of motor units recruited.

Table 1 (1).

Duration	Intensity	Energy System
0-6 seconds	Very Intense	ATP/CP
6-30 seconds	Intense	ATP/CP and Fast Glycolysis
30-120 seconds	Heavy	Fast Glycolysis
2-3 minutes	Moderate	Fast Glycolysis and Oxidative
>3 minutes	Light	Light Oxidative

An example to help understand intensity is to perform a maximum effort 100-yd sprint. Sprinting is very taxing and difficult to perform one time. Therefore the intensity would be very high and the duration of the sprint would not be long. Your body is not able to provide enough energy to continue the fast pace, so you would slow down or stop completely to perform another sprint. As a result your total TUT for a high intensity sprint is relatively short.

Energy systems also help us to understand how their activation affects hormones. Lactic acid is a by-product of glycolysis (2). Studies have shown that there is an increase in growth hormone (GH) release with higher rep (10-12) sets and decreased rest intervals (4,7). This is primarily related to the increasing levels of lactate associated with this type of training. This increase in lactate is the "pump" that many people experience during exercise. It seems that to get the glycolytic system to provide energy to the body, it is necessary to exercise for a certain amount of time and with a specific amount of intensity. This will affect the GH response, yielding bigger and better results!

TUT and Muscle Fibers

Hopefully you are starting to realize that TUT is a very important variable to use to increase your results from training. A sufficient amount of muscular tension is necessary to elicit a physiological adaptation to weight training. Weight training is essentially training the brain (nervous system) how to recruit motor units. Without losing too many people, a motor unit is a motor neuron and all the muscle fibers it innervates (5). There are 2 primary classes of muscle fibers: Type I, and type II. The type I fibers are referred to as slow-twitch. These fibers contract slowly and are harder to fatigue (6). These are the fibers primarily used when lifting light loads. The type II fibers are referred to as fast-twitch. They contract very rapidly and fatigue very quickly. Fast-twitch fibers can be broken down into types IIa and IIb. Type IIa fibers fatigue moderately and have properties of both type I and IIb fibers. Type IIb fibers fatigue easily and are used for short, high-force production tasks such as lifting heavy weights, sprinting, or jumping (6).

The fast-twitch fibers are primarily affected by lower rep sets. A decreased TUT will be used to stimulate these explosive muscle fibers, without causing too much fatigue to the nervous system. With this type of training, the brain is learning to synchronously recruit motor units in an attempt to perform the exercise.

This is why the speed of movement is very crucial. If you were to attempt to perform a set of 10 reps on the bench press, performing the concentric (positive) portion of the lift as fast as possible regardless of load, it would be impossible to replicate the same velocity on each rep. Consequently, fatigue results, and the quality of work is compromised. If the number of reps were limited to 2 or 3, the quality of work would be much higher. Conversely, if you are training for hypertrophy (where an increase in muscle size is the main goal), then a greater time must be spent under tension to elicit a GH response, fatigue motor units, and produce contractile breakdown of muscle tissue. This will help to provide the body with a stimulus for muscle growth.

Another important issue to mention at this time is a concept referred to as Compensatory Acceleration Training (CAT). CAT assists in creating a greater amount of muscular tension by voluntarily attempting to recruit the fast-twitch motor units (10). When using this in your training, you must attempt to accelerate the weight as fast as you can during the concentric part of the lift. Don't worry if the weight is heavy or moderate, if your intent is to

move the implement as fast as you can, a greater proportion of fast-twitch motor units will be recruited. This is very important to athletes that perform in sports where speed is a determining factor. This can also benefit bodybuilders. The fast-twitch muscle fibers have a greater ability to hypertrophy. What better than a way to attempt to recruit them on every single rep.

TUT Guidelines and Training Goals
Now that you have an understanding of how the energy systems and muscle fibers are related to TUT, we can get to the stuff that you can use. Refer to table 2 below:

Table 2.

Time	Energy System	Training Goal
0-15 seconds	ATP/CP; slight Fast Glycolysis	Power and Explosive Strength Training
15-30 seconds	Fast Glycolysis	Maximal Strength Training
30-60 seconds	Glycolysis (fast and slow)	Hypertrophy Training
>60 seconds	Glycolysis proceeding into Oxidative	Muscular Endurance Training

According to table 2., *Power and Explosive Strength Training* refers to a training goal where speed and rate of force development are stressed. As stated earlier, quality and speed must be stressed when training in this manner. Some examples of this type of training include medicine ball throws, dynamic strength exercises such as speed benches and speed squats, and the Olympic lifts. It is very important to accelerate the weight (CAT) with this method to create muscular tension.

Maximal Strength Training refers to a training goal where maximal strength is stressed regardless of bar speed. Loads of 85% and greater of a 1RM are most typically used in this method of training (1). You must still attempt to accelerate the weight during the concentric portion, but due to the increased load on the bar, it will appear to be moving slower.

Hypertrophy Training refers to a training goal where an increase in muscular size is stressed. The typical loads used with this method of training are dependent upon rest intervals, muscle group(s) being exercised, and tempo (speed of movement).

Muscular Endurance Training refers to a training goal where consistent force production can be maintained over a prolonged interval. Lighter loads are typically used with this method of training.

How and Why Should I Use TUT?
Now you will see how you can use those guidelines. Let's say that you are in a phase where the primary goal is hypertrophy. Traditional rep ranges would recommend that you perform a set of 10 reps. However, if you complete your set at a blazing speed, you may be done in only 20 seconds. According to the TUT guidelines stated above, you would not be imposing a great deal of tension upon your muscles to elicit an adaptation. However, if you had your partner time your set (instead of completing a specific number of reps) you could ensure that you were training the proper energy system to attain your training goal.

Rep ranges are still an option, especially if you work out alone, but the number of reps performed depends upon the tempo of execution. Tempo (speed of movement) is vital in developing exercise technique, developing eccentric strength, increasing connective tissue strength and busting through stubborn training plateaus. It is an excellent way to monitor your total TUT. Very few people pay attention to the tempo. Next time you go to the gym, look around and see how many people actually control the weight. It looks more like the weight is controlling them.

The notion of using a tempo comes from strength coaches Ian King, and Charles Poliquin. It is a 3 number

system, where the first number indicates the length of the eccentric portion (with gravity). The middle number is the length of the pause in the stretched position, and the third number is the length of the concentric portion (against gravity). For example, a 3/1/X tempo in the bench press, would require the lifter to lower the weight in 3 seconds, pause for a second, and then press the bar as fast as possible (X). Following this approach it would take 5 seconds to execute one repetition. If training for power, you only perform about 2-3 reps (10-15 seconds total TUT), but if you were training for hypertrophy you would perform 6-12 reps (30-60 total seconds TUT). As you can see, the tempo and reps can be manipulated depending upon your training goals. Try to change your rep tempo about every 3-4 weeks. Muscles gain faster strength if you train them at various speeds, rather than using the same speed all the time (8,9). Tempo should be changed just like any other training variable to force the body to respond to a different stimulus. A general rule of thumb is that a faster tempo is usually used for power and explosive strength training, while a slower tempo is used in hypertrophy to increase the TUT. Refer to the training tips table below.

Use these guidelines as a scientific means of monitoring progress and overload. TUT should be used as a change of pace to your athletes, clients, or even your own workouts.

Training Tips Table

1. When training the nervous system (power, strength), quality *must* be stressed over quantity.
2. An intention on moving the weight as fast as possible is imperative. No matter if the implement is heavy or moderate. If the intent is to move the weight as fast as possible, a greater proportion of fast twitch motor units will be activated, which is vital for those sports where speed is crucial (i.e. explosive-strength and power).
3. When training for hypertrophy (size, mass), volume must be stressed. This ensures that the muscle(s) will be fatigued and all motor units will be activated to stress muscular hypertrophy.

What Time You Got?

Realize that TUT is simply a variable that can be used as measuring training progress. It may be used for variety by those who have run into a plateau, or to spark up a dull program. Keep in mind that these guidelines are not written in stone, and some people may need to experiment using different time ranges per set. Hopefully, this has stimulated your interest in this underused training variable as a means of maximizing upon your particular training goal. Next time you hit the gym, stop wasting your time and keep your eyes on the clock!

I would like to thank my good friend, Charles Maka, with his input on these TUT guidelines.

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